The Preliminary Exploration of the E-lenz Children's English Learning Device Interface Design

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Abstract
In recent years, remote learning has become prevalent in the lives of children, with numerous online learning platforms and tools entering the market. Children are compelled to adapt to digital devices for learning, making digital education a new and prominent development direction. However, some studies indicate that certain learning applications emphasize content at the expense of the crucial user experience, resulting in overly complex interface designs that pose difficulties for users and consequently impact the learning process. In order to facilitate children's comprehension and rapid adaptation to new educational systems, designing a clear, understandable, and user-friendly interface coupled with corresponding learning methods has become a necessary task. To alleviate cognitive burdens on children and enhance their ability to focus on learning, this research focuses on the "E-lenz Assistive Learning Device," primarily designed for teaching children English pronunciation. Utilizing the expert interview method and incorporating recommendations from English education professionals regarding instructional models, tablets serve as the learning tool in conjunction with interactive learning cards equipped with sensors. Through embedded instructional videos and triggered sound effects within the cards, the digital learning model is restructured. Throughout the design process, principles of child interface design are upheld to create the user interface and instructional model for the E-lenz Assistive Learning Device, addressing and minimizing interface complexity issues during children's use of learning aids. This research introduces a novel approach to English language learning.

Keywords: Self-Directed Learning, English Teaching, Interactive Teaching, Post-pandemic Era, Tablet

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Introduction

The impact of the pandemic, coupled with technological advancements, has spurred the rapid development of online and self-directed learning, leading to a comprehensive transformation of educational methodologies across all levels. With improvements in technology and internet services, digital content, online courses, language learning apps, gamified learning software, and various formal and informal remote teaching and tutoring methods have emerged as new learning modalities. Digital content has reduced learning costs and expanded the audience reach.

Paul Gilster defined the term "Digital Literacy" in 1997 as "the ability to understand and use information in multiple formats from a wide variety of sources when it is presented via computers." In the current context where mobile devices are ubiquitous, the Taiwanese government has proposed strategies to align with this development trend. In the Ministry of Education's plan to enhance digital learning in primary and secondary schools, it is stated that starting from 2022, the government will invest a total budget of 20 billion NTD over four years to ensure that every student from grades 1 to 12 has access to tablet-assisted learning. This demonstrates that digital device-based learning has become one of the essential learning methods today (Wang Jinguo, 2023).

Integrating information and technology into teaching is a hot topic, but it is seldom addressed in the field of early childhood education. Relevant regulations and curriculum standards, such as the "Early Childhood Education and Care Act," the "Provisional Curriculum Guidelines for Preschool Activities," and the "Evaluation Form for Preschool Curriculum and Teaching Quality," rarely mention the use of technology and digital media (Su Xiuzhi, 2015).

New Trend of Learning

Mobile learning fully utilizes mobile devices to transcend geographical limitations and sustain user engagement. Despite the advantages of existing applications, some mobile learning programs, including those for children, face issues such as unattractive interfaces and complex designs, causing confusion among children (Latiff et al., 2019). Furthermore, research indicates that integrating technology into teaching methods effectively enhances learning outcomes, reduces cognitive load, improves the learning experience, and promotes self-directed learning (Thapaliya et al., 2024). However, in the context of English learning, many learners encounter difficulties in accessing courses and lack digital skills, leading them to seek alternative platforms. These challenges affect the satisfaction with online education and negatively impact learners' outcomes (Mahyoob, 2020). Therefore, the usability and intuitive design of educational platforms are critical factors influencing the user experience.

During the learning process, if learners are exposed to too many different types of media elements (text, visuals, audio) simultaneously, their cognitive load can increase. Cognitive load theory refers to the load generated when the information received exceeds the capacity of the brain's working memory or short-term memory, causing learners to engage in irrelevant cognitive processing. This additional cognitive load can reduce learning effectiveness (Tindall-Ford et al., 2020). Nelson and Erlandson pointed out that in multimedia information processing, cognitive load is influenced by the instructional design or material design, which affects the pressure and effort learners experience (Nelson & Erlandson, 2008). This cognitive load should be mitigated through instructional design changes; appropriate material design can reduce cognitive load and thereby enhance learning

outcomes (Paas & Sweller, 2014). Additionally, child-friendly interface design can not only enhance educational experiences but also promote skill development and cognitive abilities. By combining age-appropriate graphics, intuitive navigation, and interactive elements, digital platforms can effectively capture children's attention and ensure positive learning outcomes (Achdiani et al., 2021). For example, adding graphics to the curriculum can increase its attractiveness, positively impacting learning (Mayer, 2014).

Noetel et al. reviewed 29 studies and proposed five principles that significantly improve cognitive load management: (1) providing subtitles in second language videos, (2) temporal/spatial continuity, (3) signaling, (4) coherence/removal of unnecessary details, and (5) segmentation (Noetel et al., 2022).

In line with current trends, learning methods and materials utilizing mobile devices (such as tablets) are prevalent in the market. However, some learning applications focus on content while neglecting the importance of the user experience. Therefore, combining intuitive user interfaces with paper-based materials to promote children's understanding has become an important task. When developing mobile learning interfaces, designers and educators should prioritize user-centered design principles and consider the unique needs and abilities of children (Ahmad Faudzi et al., 2023).

This study aims to improve existing digital learning interface designs, with the goal of reducing cognitive load. Specifically, the study aims to review literature to outline the impact and current state of cognitive load on children in digital learning. Through this research, the study intends to integrate design elements that meet children's learning needs, reveal their motivations and challenges in digital learning, and compile design guidelines to reduce cognitive load. The study will develop the interface prototype for the English pronunciation learning device "E-lenz," which includes understanding user challenges and difficulties with courses and teaching, and conducting practical aspects of interface design. Based on interface design principles, the study will propose improved design methods and recommendations to provide children with a more intuitive user interface for English learning, enhancing their willingness to learn. The findings of this study will contribute to the existing body of knowledge in digital education by providing the latest and most comprehensive research results.

Discussion

In this study, we found that existing digital learning tools often lack child-friendly interface designs, which increases cognitive load and hinders learning outcomes for children. We attempted to reduce cognitive load in digital learning through a series of design strategies, aiming to enhance both learning effectiveness and motivation among children.

In terms of curriculum, teachers must continuously adapt their courses and teaching methods to keep pace with technological advancements, ensuring that students can follow the ever-changing learning models. This brings to light an important issue. As Su Xiuzhi (2015) noted, while digital learning has become a hot topic in education at various levels, it is seldom addressed in early childhood education. Experts and scholars remain cautious about the use of technology and digital media for young children. Therefore, there is a need for deeper exploration into how technology and digital media can be integrated into early childhood education to improve learning outcomes.

Latiff et al. (2019) emphasized that to create a supportive and inclusive learning environment, educators need to focus on child-friendly interface design, visual and auditory design features, and feedback and reward mechanisms. These design considerations are crucial for reducing cognitive load in digital learning for children. Designing a supportive and inclusive learning environment is also a challenging task. We need to consider how digital teaching can alleviate teacher stress while providing personalized learning experiences for each student and promoting peer collaboration. This requires careful thought and meticulous design.

Krippendorff (2013) highlighted that the key components for the successful acceptance of mobile learning applications by users are usability, appeal, and user-friendliness. Therefore, we need to design digital learning tools from these perspectives to effectively reduce cognitive load for children.

Our research has demonstrated the importance of integrating child-friendly design elements into digital learning tools to enhance learning experiences. By focusing on usability, intuitive navigation, and engaging visual and auditory elements, we can create digital learning environments that not only facilitate better learning outcomes but also increase motivation and engagement among young learners. The development of the "E-lenz" English pronunciation learning device's interface prototype exemplifies this approach, providing practical insights into designing effective digital learning tools for children. This study contributes to the existing body of knowledge in digital education by offering comprehensive and up-to-date research findings that can inform future developments in the field.

Design Process

This study follows a three-step approach: firstly, conducting user needs surveys and literature analysis to understand the issues and requirements of children's interface design. Secondly, based on the literature and design principles, prototype design of the "E-lenz English Learning Machine" user interface is conducted. Finally, prototype evaluation and subsequent recommendations are carried out to refine and improve the development of the "E-lenz English Learning Machine."

Drawing from the relevant literature, four effective design principles for reducing cognitive load are summarized and integrated into the research to alleviate users' cognitive burden:

1. Maintain consistency of information: When designing multimedia learning materials, arrange related information reasonably to avoid distracting learners or increasing cognitive load. Utilize appropriate visual and auditory elements to aid sequential understanding and memory.

2. Use clear signals: Guide learners' attention to key information or organize information effectively using visual cues such as highlights, colors, arrows, as well as auditory elements like tone, pace, or animations and charts to reduce the cognitive load of processing unnecessary information.

3. Reduce unnecessary details: Identify and eliminate extraneous or irrelevant information after determining learning objectives to prevent attention dispersion. Present only essential information required to complete tasks, using concise language and graphics to reduce information overload.

4. Provide appropriate guidance: Clearly communicate learning objectives and tasks, offer timely feedback to help learners understand their progress and effectiveness, correct errors, and facilitate effective learning.

5. Promote active learning activities: Encourage learner participation in interactive exercises and feedback to reinforce learning outcomes and alleviate the cognitive burden of passive learning.

Based on the literature review, this study addresses recommendations and challenges in children's digital learning, and outlines the structure and scenarios of digital learning materials. The main focus of this research is on the interface design of educational materials, including functionalities such as (1) homepage for selecting learning units, (2) pronunciation exercises with physical card-sensing machine to generate learning audio, (3) learning videos accessible by scanning QR codes on cards, and (4) rewards collection to provide feedback to children. Detailed functionality descriptions will be provided in the subsequent results section.

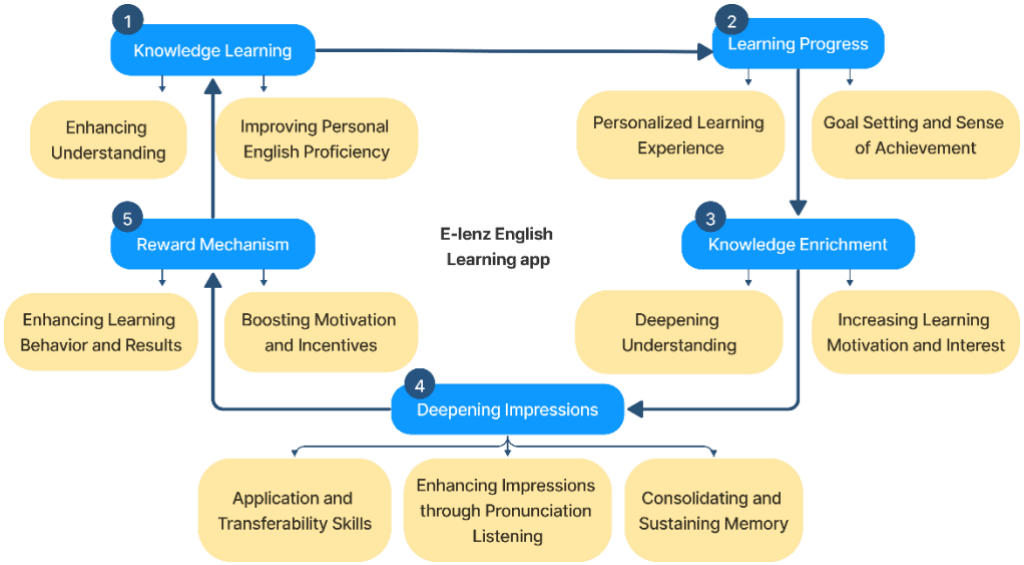

Figure 1: Conceptual Framework

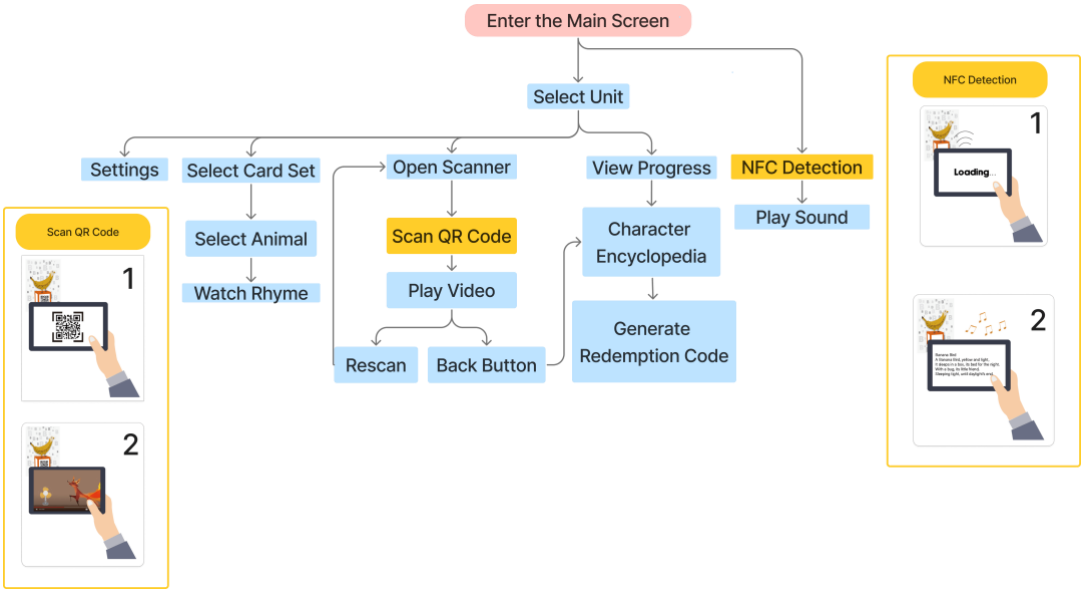

Figure 2: Functional Map

The User Interface (UI) is the medium for information exchange and interaction between the system and the user, converting system information into a form that is understandable and easily operable by humans. The success of mobile learning applications depends on their usability, attractiveness, and user-friendliness (Krippendorff, 2013). Research on children's use of application interfaces highlights the need to consider the following features:

1. Child-Friendly Design: Includes cartoon-style illustrations and easy-to-read fonts.
2. Visual Design: Utilizes bright colors and extensive use of graphics.
3. Sound Design: Incorporates cheerful background music and sound effects.
4. Feedback and Reward Mechanisms: Uses sound effects and animations to encourage children and provide immediate feedback.

This study will design the interface based on these considerations (Latiff et al., 2019).

Results

At this stage, based on the previous phases, we consolidated the functionalities and user flow to design the "E-lenz English Learning Device" user interface framework and prototype. We visualized the necessary functional buttons, and the design outcomes are as follows.

Figure 3: E-lenz UI Screen Design

We based our design considerations on the five points mentioned earlier to reduce cognitive load (Figure4). The first point, "Maintain consistency of information," is applied by integrating functional pages into beige-colored blocks and placing them at the bottom of the screen (number 6); within units, titles, texts, and images are grouped using white boxes (number 13); and by establishing group relationships among images of the same animals using dotted lines to guide users to swipe left or right to select words to learn (number 4). The second point, "Use clear signals," is demonstrated in rhyme lessons, where students can listen to the teacher recite poems using learning cards (number 5), and in the layout, where clear page prompts and flashing prompts upon task completion guide users' understanding (numbers 9, 12). In the third point, "Reduce unnecessary detail," we adopt a minimalist approach by using single-color line icons to avoid distractions from overly vivid designs (number 6); some screens use rounded color blocks to differentiate buttons, with text in non-blocked fonts and bold formatting to gradually reduce reading burden (numbers 1, 7). The fourth point, "Provide appropriate guidance," is implemented during the scanning of learning cards, where animals act as guides, and textual prompts mitigate usage difficulties, with icons indicating page numbers where flipping is required, enhancing effective learning (numbers 2, 3, 11). Finally, in the fifth point, "Promote active learning activities," children are encouraged through collection mechanics to use learning cards and watch instructional videos to earn certificates (numbers 8, 10, 14); auditory feedback during card scanning fosters a sense of achievement upon task completion.

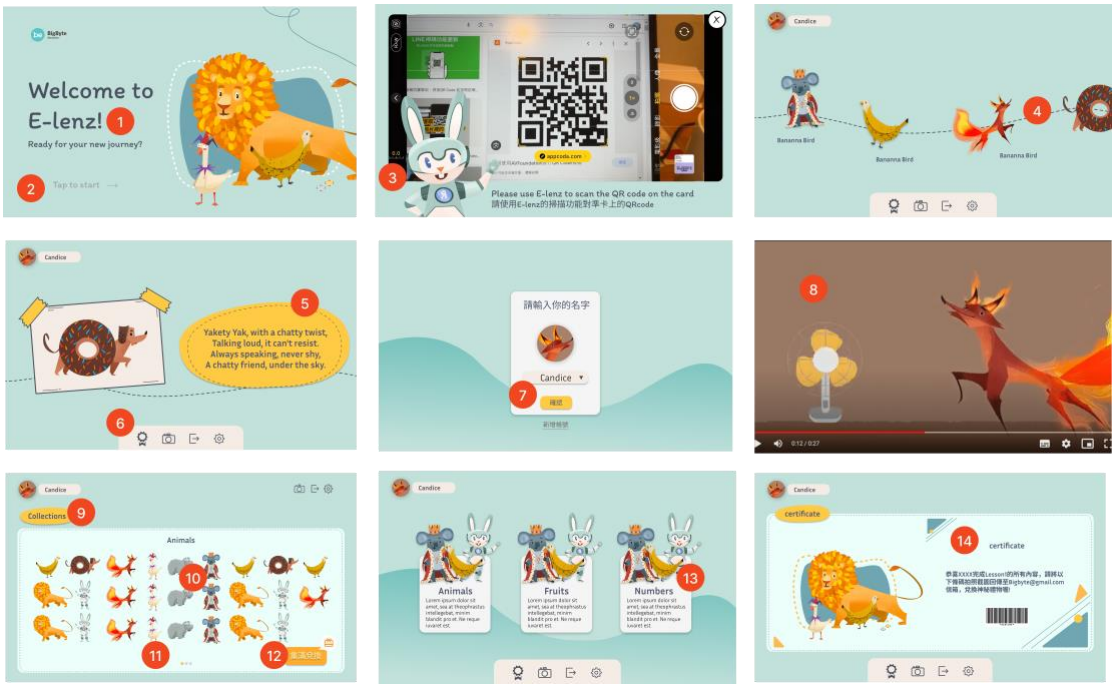

Figure 4: E-lenz Prototype

Conclusion

In this study, we underscored the importance of reducing cognitive load for children in digital learning through expert opinions and literature review. We adopted design principles proposed by experts, such as maintaining information consistency, using clear signals, and reducing unnecessary details. Additionally, we incorporated child-friendly interface design features mentioned in the literature, such as bright, soft colors and rich visual and auditory effects, to enhance the attractiveness and interactivity of learning. These principles were applied to the user interface design of the "E-lenz English Learning Machine." Through these applications, we aim to improve children's learning outcomes and motivation while providing valuable insights for the education sector to address the challenges of digital learning.

This study emphasizes the importance of considering the reduction of cognitive load when designing digital learning tools for children and implements this principle in design. Future research will further explore diverse learning modes through usability testing and expert interviews to enhance the effectiveness and relevance of design. Collaboration with the education sector will be sought to drive innovation in teaching methods and cultivate a new generation of learners who can effectively utilize technology.

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